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ABSTRACT

The effects of learner control in Computer Based Instruction (CBI) were compared to learner control with advice as to what content to see next, and to programmed control. Students in training at the Basic Electricity/Electronics School, Service Command, Naval Training Center, San Diego, served as subjects in this study. Materials used were four lessons on using a multimeter. Students were assigned randomly to one of three treatment modes: learner control (student is free to choose individual lesson segments and content within lesson segments without restrictions on the order in which he sees individual materials or on how often he sees them); learner control with guidance (used an unobtrusive arrow superimposed on the lesson index or content choice page to recommend which lesson segment or lesson content the student should select next); or programmed control (imposed the same guidance parameters prescribed for the guided group but without choice). There was no significant difference in performance among the three groups. Following completion of the lessons, each student was asked to fill in an attitude questionnaire; there was no significant difference in the attitude towards CBI as a result of the different treatments. (VT)

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LEARNER CONTROL OF COMPUTER-BASED INSTRUCTION: A COMPARISON TO GUIDED INSTRUCTION

by

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LEARNER CONTROL OF COMPUTER-BASED INSTRUCTION: A comparison to guided instruction

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Following Mager's findings (Mager, 1961; Mager and McCann, 1961; Mager and Clark, 1963) that student control of the learning situation facilitates learning, learner control has been applied for study in a variety of settings. Researchers have investigated its utility in the classroom and in computer-based instruction (CBI). In an analysis of the possible advantages of learner control, Merrill (Merrill, 1973; Merrill and Boutwell, 1971) theorized that learner control would be instrumental in the acquisition of learning strategies that optimize the student's learning process, and that make the learner independent of rather than dependent on the teacher's strategies. However, in their reviews of the literature, Judd, O'Neil and Spelt (1974) and Steinberg (1977) find a fairly consistent pattern of no differences in test performance after training, and only parsimonious indication of long-term effects.

In an earlier study of the use of learner control in two CBI lessons (Lahey and Crawford, 1976), we found no evidence that students were switching to a 'learned' strategy, nor that selection of one strategy over another significantly affected lesson performance. This led us to question whether strategies would change if the time were extended, and whether learner control students would do better if they were given advice as to what type of lesson content to see next. We also wanted to test whether learner control was superior to adaptive programmed control. This paper describes then a research study in which we compared the effects of learner control to learner control with advice as to what content to see next and to programmed control.

Method

Students in training at the Basic Electricity/Electronics School, Service Command, Naval Training Center, San Diego served as subjects in this study. The lesson materials used for the study were four lessons on using a multimeter, one on measuring resistance (hereafter called the ohms lesson), one on measuring DC current flow (hereafter called the amps lesson), one on voltage in series circuits (voltage) and one on measuring DC and AC voltages (volts). Between the first and second lessons, the students took a hands-on performance test using the multimeter as an ohmmeter, and a module examination covering resistances and resistance measurement. Following the fourth lesson, the students took a hands-on performance test using the multimeter to measure current flow and voltages and a module examination covering current flow and voltage in series circuits.

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[1]The research effort described in this paper was supported as part of an Advanced Research Projects Agency/Joint Services Training Technology Program for development of computer-based training technology. The position and opinions reflected in this paper are those of the author and do not reflect an official Navy position.

Students were assigned randomly to one of three treatment modes; learner control, learner control with guidance, or programmed control. The treatments were essentially as follows:

The learner control mode used in this study was essentially that described in Lahey, Crawford, and Hurlock (1976), wherein the student is free to choose individual lesson segments and content within lesson segments without restrictions on the order in which he sees individual materials or on how often he sees them. The individual lesson segments contain rules, examples, practice problems, and expository helps at easy, medium, and hard levels of difficulty. The student choses lesson segments from an index such as that shown in Figure 1, then chooses lesson content selectively, as is indicated in Figure 2. The option block presented at the bottom of each individual frame of the lesson content lets the student choose what he will see next by pressing the PLATO IV touch panel. To prevent fixation on a particular order, the relative positions of the rule, examples and practice option blocks are randomly varied for each presentation.

The second form of the learner control mode used an unobtrusive arrow superimposed on the lesson index or content choice page to recommend which lesson segment or lesson content the student should select next. The basic parameters used for guidance were a numerical sequence of lesson segments, and a rule-example-practice sequence of lesson content. The guidance function parameters for lesson content were however adaptive, as is indicated in Figure 3. The guidance function in essence asked, "What is the student seeing now?" and "What has he previously seen?", then it selected a recommendation based on his progress to date. Students in the guided learner control mode could start a lesson segment at the easy, medium, or hard level of difficulty with either the rules, an example, or a practice problem. After they had made a free initial choice, the guidance function (Advisor) came into play to recommend what to select next.

The programmed control mode imposed the same guidance parameters prescribed for the guided group but without choice. Programmed control students started out at the medium level of difficulty rule, followed by examples, and followed by practice problems. Their subsequent history depended explicitly on their success/failure history with the medium level practice problems. Failure to correctly answer practice problems could conceivably take the student to the easy rule, from whence he would have to work his way back to successful completion of the hardest practice problems in that lesson segment before going on to the next lesson segment. All branching was computer controlled, with no options given.

Results and Discussion

The performance data of the three experimental groups are presented in Table 1. There were no significant differences in performance between the three groups. Only the number of responses made during the initial lesson (ohms) and the short third lesson (voltage) differed significantly for the programmed control group. These differences were due primarily to the fact that the learner control students could opt for easy level content while the programmed control students could not.

SUBJECT MATTER AREAS: AMMETER LESSON.

↓

1. JACK LOCATIONS.
2. DEENERGIZING CIRCUITS.
3. CONNECTING THE METER.
4. OBSERVING POLARITY.
5. ENERGIZING CIRCUITS.
6. SETTING THE FUNCTION SWITCH.
7. READING THE DC SCALE.
8. SETTING THE RANGE SWITCH.
9. MINI-LAB

T. ** PROGRESS CHECK **

SELECT A SUBJECT BY NUMBER:)

PRESS HELP FOR ADDITIONAL OPTIONS.

ORDER OF PRECEDENCE:

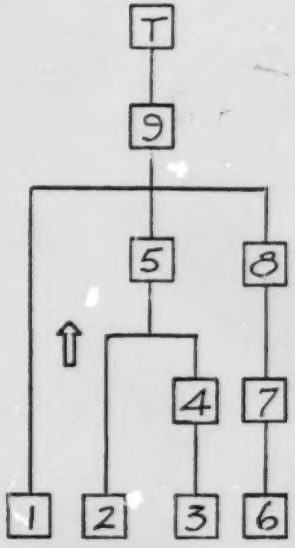

Figure 1. Learner Index, amps lesson

WHEN MEASURING RESISTANCE, YOU'LL NEED TO FIND TESTPOINTS (TP'S) TO USE WHICH ISOLATE THE RESISTANCE YOU WANT TO MEASURE. THE BEST WAY TO SEE THIS IS BY EXAMPLE. BE SURE TO TRY SEVERAL.

EXAMPLE	RULE	PRACTICE	EASY	MED.	HARD	HELP	INDEX

Figure 2: Sample Objective Page, Ohms Lesson.

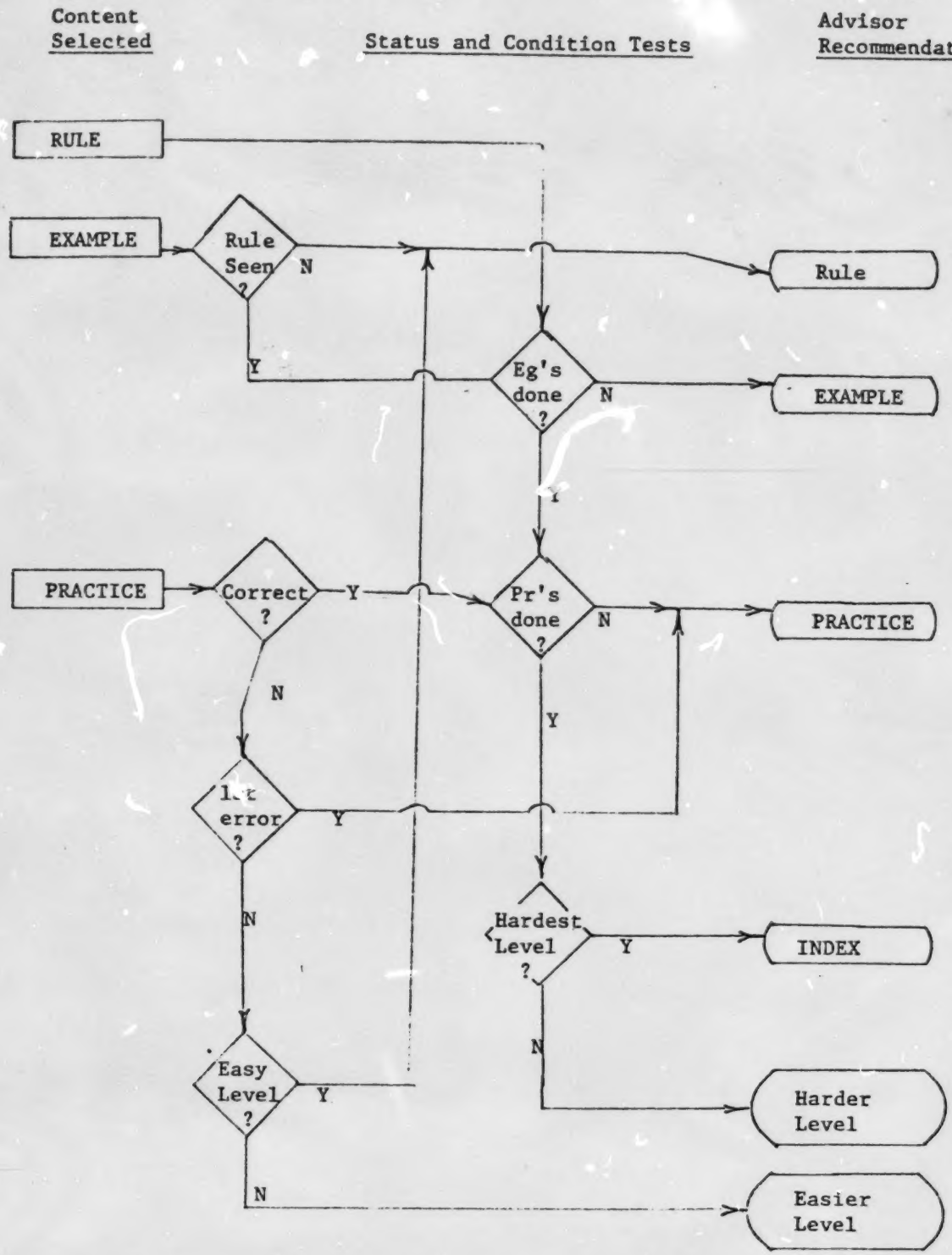

Figure 3: Advisor Subroutine

Table I

Overall Performance Analysis

	Learner Control	Advisor	Programmed Control	Controls
Ohms lesson:				
Test score (%)	80.1	81.0	84.6	—
No. responses	216	231	163*	—
Time (hrs)	2:05	2:14	1:49	
Module 3:				
Trials, perf. test	1.1	1.4	1.3	1.2
Errors, mod. exam	2.4	2.1	2.3	1.7
Amps lesson:				
Test score (%)	72.3	66.1	73.0	--
No. responses	249	243	204	--
Time (hrs)	1:57	1:59	1:46	--
Voltage lesson:				
Test score (%)	93.6	95.1	95.5	--
No. responses	68	65	47**	--
Time (hrs)	0:26	0:26	0:22	--
Volts lesson:				
Test score (%)	85.6	88.8	87.3	—
No. responses	215	230	217	--
Time (hrs)	1:41	1:52	1:45	—
Module 4:				
Trials, perf. test	1.8	1.8	1.6	1.7
Errors, mod. exam	0.8	0.9	1.0	0.8

* $p < .01$, ** $p < .001$

It was necessary to confirm that the strategies used within the three treatment groups were indeed different, since learner control could have little impact if it resulted in the same training sequences as were used in the programmed control mode. Therefore, the individual paths taken by each student were examined to confirm that the groups used different lesson strategies. We found that the guided group had selected lesson segments in order more frequently than the learner control group in all four lessons, df = 1, χ^2 in excess of 7.0, $p<.01$, and less frequently than the programmed control group in three of the lessons, df = 1, χ^2 greater than 7.2, $p<.01$. In the short third lesson, 43 of the 44 guided students chose the 4 lesson segments in the numerical sequence.

The guided students also selected strategies recommended by the guidance function (Advisor) more often than the unguided group df = 1, $\chi^2 = 31.09$, $p<.01$ and less often than the programmed control group, df = 1, $\chi^2 = 13.9$, $p<.01$. The analysis confirms that the treatments included differences in the lesson strategies used which presumably could have resulted in differences in lesson performance. As in our previous study (Lahey and Crawford, 1976), there was no evidence of switching to a learned strategy during the later lessons for either of the learner control groups.

In an a posteriori analysis of the data it was found that learner control students who adopted a rule-example-practice strategy did better on three of the four lesson tests than those who did not: df = 1, 80; MSW = 175.4 and F = 8.10 in the ohms lesson, MSW = 7.15 and F = 80.0 in the voltage lesson, and MSW = 29.8 and F = 80.0 in the volts lesson; all significant at the .01 level. There was no significant difference between the performance of the a posteriori groups during the amps lesson, perhaps because of the difficulty of this lesson. The performance of the a posteriori groups is presented in Table 2. The performance of the a posteriori rule-example-practice group did not differ from that of the programmed control treatment group in any of the lessons.

Following completion of the lessons, each student was asked to fill in an attitude questionnaire. Analysis of this questionnaire indicated no significant difference in the attitude towards computer-based instruction as a result of the different treatments.

The results are consistent with an expectation that students tend to follow the instructor's guidance, though they are capable of choosing other paths. The results also seem to indicate that learner control has no immediate pedagogical advantage over adaptive programmed control. Moreover, giving the learner control guidance, while effective in directing the path students take through the lesson, does not significantly reduce the time they spend in the lesson nor constructively reduce number of responses made.

Table 2

Lesson Test Performance as a Function of Strategy Selection, Collapsed Over Learner Control and Advisor Groups

	Dominant Strategy	
Lesson	Ru-Eg-Pr	Other
Ohms	83.5	74.9*
Amps	71.2	68.1
Voltage	96.2	91.5*
Volts	88.2	77.1*
Number of students	51	31

* $p < .01$

Conclusions

The results suggest that learner control, guided or unguided, may have no significant pedagogical advantage over adaptive programmed control. It also appears that the motivational advantage presumed in earlier studies may have been primarily a function of the novelty of the presentation, since in this study all three modes were novel and all three modes seemed to be received equally enthusiastically. However, while it appears not to offer an immediate pedagogical advantage to the student, the learner control mode of instruction may be chosen in the long run for other reasons, such as economy of lesson development or, if proven, for the long-term effects postulated by Merrill (1973).

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